MANNED SATELLITE PROJECTS
GROUND COMMUNICATIONS
RELIABILITY REPORT

PROJECT MERCURY

MARCH 1963

GODDARD SPACE FLIGHT CENTER
GREENBELT, MD.

MANNED SATELLITE PROJECTS
GROUND COMMUNICATIONS RELIABILITY REPORT
FOR
PROJECT MERCURY

March 1963

Prepared by

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GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

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INTRODUCTION

General

This report is the result of an analysis of the Mercury Communications Network performance for the month of March 1963 and a comparative network analysis covering the preceding three to twelve months.

Project Mercury network teletypewriter, voice, and high speed data circuits connecting Goddard Space Flight Center (GSFC) with the stations listed in Table 1 as well as the several continental U. S. stations were evaluated with respect to reliability.

In addition to the stations included in the analysis, very useful monitoring/reporting functions were performed by Honolulu and London. Only those circuits to sites directly supporting a Mercury mission are normally included in these reports. Current exceptions are the Houston and Johannesburg voice circuits and the circuits to the Adelaide Communications Center. While Adelaide is not actually a Mercury site, it is in operation on a 24-hour per day basis, thereby providing extremely useful data on the Honolulu to Sydney radio path. Thus, a more valid evaluation of the capabilities of the circuits to Australia is possible than could be obtained by analyzing the Australian sites (Muchea and Woomera) alone without Adelaide.

Table 1
Teletypewriter Circuit Reliability (Percent)

	OCT	NOV	DEC	JAN	FEB	MAR
Adelaide	99.32	98.35	98.84	98.79	93.76	97.43
Bermuda (cable only)	99.53	99.62	98.61	99.73	98.78	99.78
Canton Island	99.26	99.25	98.26	98.25	96.65	96.63
Grand Canary Island	98.91	98.81	96.11	95.44	97.36	99.19
Guaymas, Mexico	98.31	98.56	99.39	98.54	98.75	98.67
Kano, Nigeria	99.20	99.46	97.56	95.38	97.99	98.47
Kauai Island, Hawaii	99.78	99.30	99.56	99.33	99.87	99.70
Muchea, Australia	99.24	98.71	97.50	98.20	98.18	98.23
Woomera, Australia	97.05	98.98	98.53	97.24	98.78	98.18
Zanzibar, Africa	98.98	98.53	97.24	95.92	96.22	98.58

Reliability

Reliability is defined as the "state or quality of being dependable or trustworthy." Thus, the reliability of a communication circuit is the degree of dependability or trustworthiness of that circuit. This can be stated as a ratio (expressed in percent) of the actual time the circuit is available for carrying traffic to the total scheduled operating time.

Two criteria are used in arriving at the degree of Mercury circuit reliability. The first is based on the ratio of realized circuit operating time to the total scheduled time of circuit operation. Any difference between these two would be the result of circuit interruptions due to a variety of reasons. The second criterion—error rate—is the ratio of the number of correct characters counted in a received teletype message compared with the total number of teletype characters transmitted. This is then expressed in percent.

A more comprehensive circuit reliability evaluation may now be arrived at by obtaining the product of these two factors, i.e., multiplying the percentage of operational reliability by the error rate reliability with the product expressed as a percent. This is termed "composite reliability."

Shown in Figure 1 is operational reliability (reliability based on outage time), which, it will be noted, very closely parallels the curve of the product of operational reliability and error rate reliability. In previous reports, the composite reliability curve has been shown only for the network as a whole. However, in this and future reports, a composite reliability curve will be shown for each of the individual section analyses.

The average long-term reliability—of either a station or a circuit—considered over a period of several months is determined by adding all outage time in a selected number of months. This total is divided by the total scheduled time of circuit or station operation. This result is then subtracted from 100 to obtain the degree of reliability in percentage.

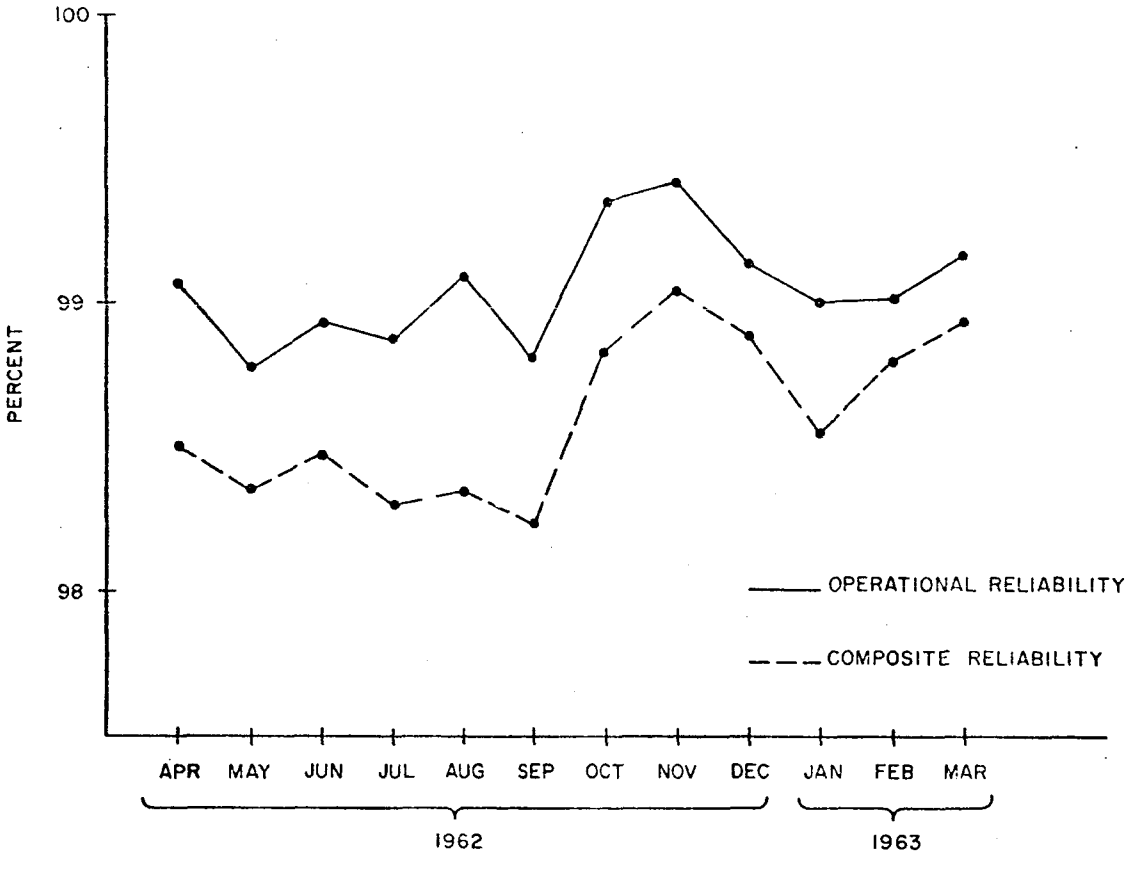


Figure 1. Network Reliability (Percent)

Transmit-Receive Circuits

It should be noted that an analysis of reliability in this report is made on a transmit circuit, and then on a receive circuit, each on an individual basis. "Transmit" refers to transmissions from Goddard, and "receive" refers to reception at Goddard from the outlying sites. For the sake of clarity and to avoid confusion, this convention will be used throughout this report. In previous Mercury network reports, transmit and receive lost time and reliability were combined and analyzed on this basis. In this and future reports of the Mercury network, performance of the transmit and receive paths of the several circuits will be analyzed on an individual basis, since it is believed this will furnish information that will be more meaningful.

Prior to November 1962, reliability of the circuits of the Mercury network was analyzed and considered only with the transmit-receive circuits combined. As a result of this policy, the long-term graphical analysis of these circuits will continue for the next several reports to show these analyses on a combined transmit-receive basis in order to present a relative comparison on this same basis. When additional months' data has accrued (by October 1963) so that a twelve months' graphical analysis can be presented of each of the transmit and receive circuits on an individual basis, the combined transmit-receive analyses of the circuits will be discontinued. Table 2, however, does present in tabular form, beginning with November 1962 and including the succeeding months through March 1963, a reliability analysis of the transmit and receive paths on an individual basis.

NETWORK TELETYPEWRITER PERFORMANCE ANALYSIS

Network Reliability

In March, the operational reliability of the Mercury Communication Network was higher than it has been in any month since November 1962 (November 99.42 percent; March 99.16 percent). The three categories which have usually been the cause of the greatest amount of lost network time are line-cable-microwave failure, equipment failure, and poor propagation (see Fig. 2). Collectively, the lost time decreased only slightly from

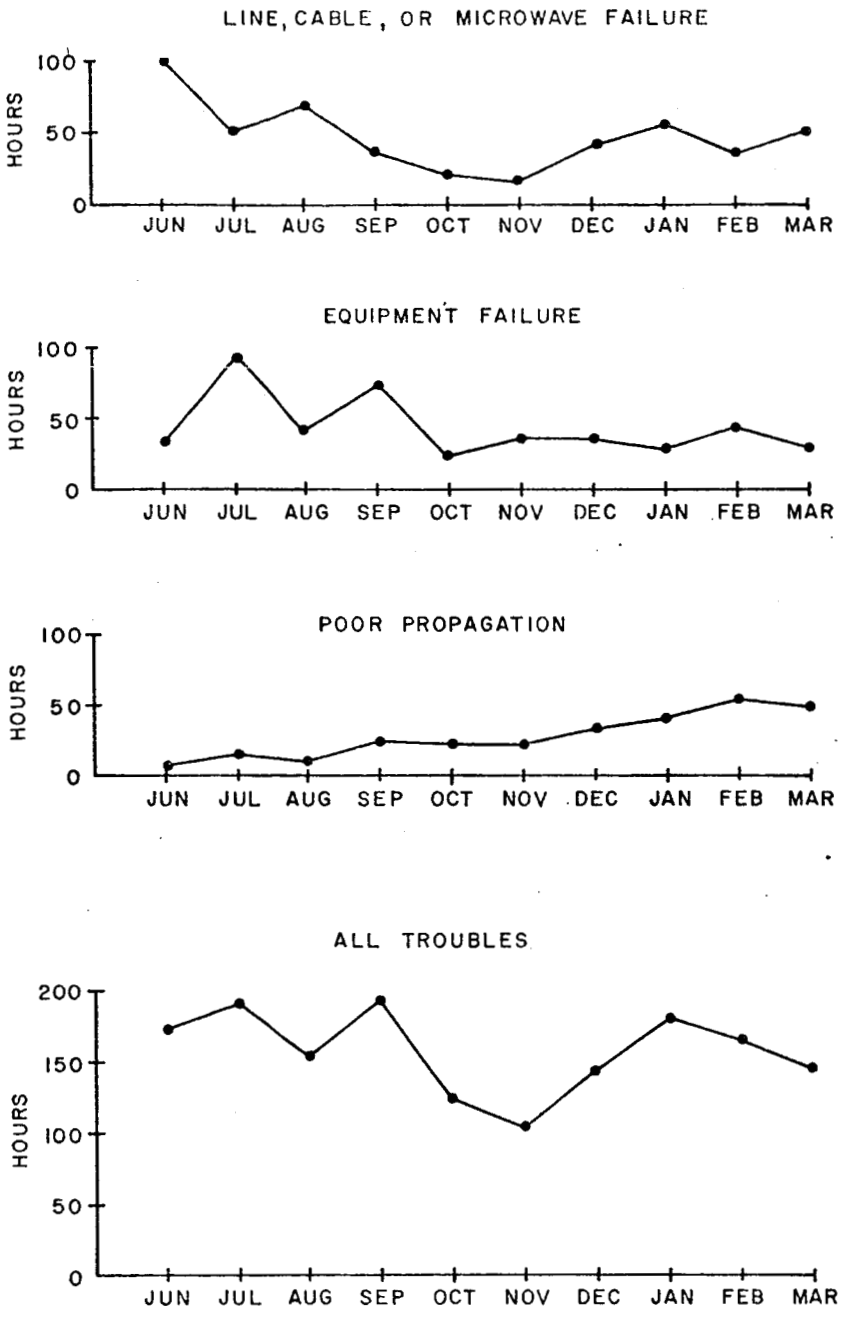


Figure 2. Network Time Lost by Trouble Categories (Hours)

February to March (February 133 hours; March 129 hours); therefore, these three categories were not the reason for the substantially improved reliability in March. The trouble category which did exhibit the greatest decrease in outage time was no-trouble-found, which was about 23 hours in January, 36 hours in February, and less than 6 hours in March.

Lost time attributed to poor propagation was somewhat lower in March than in February, but in spite of this the upward trend experienced in propagation outages over the past several months is continuing.

Figure 3 is an expanded graph (18 months) of outage time due to poor propagation. This graphical presentation shows the outage time due to poor propagation from February 1962 through March 1963. In addition, projected propagation outage time is shown by the dashed line through June 1963. This projection was first shown in the December 1962 report and was based on NBS long-term propagation predictions. It was included as a means of acquainting interested operations personnel with the anticipated long-term propagation conditions.

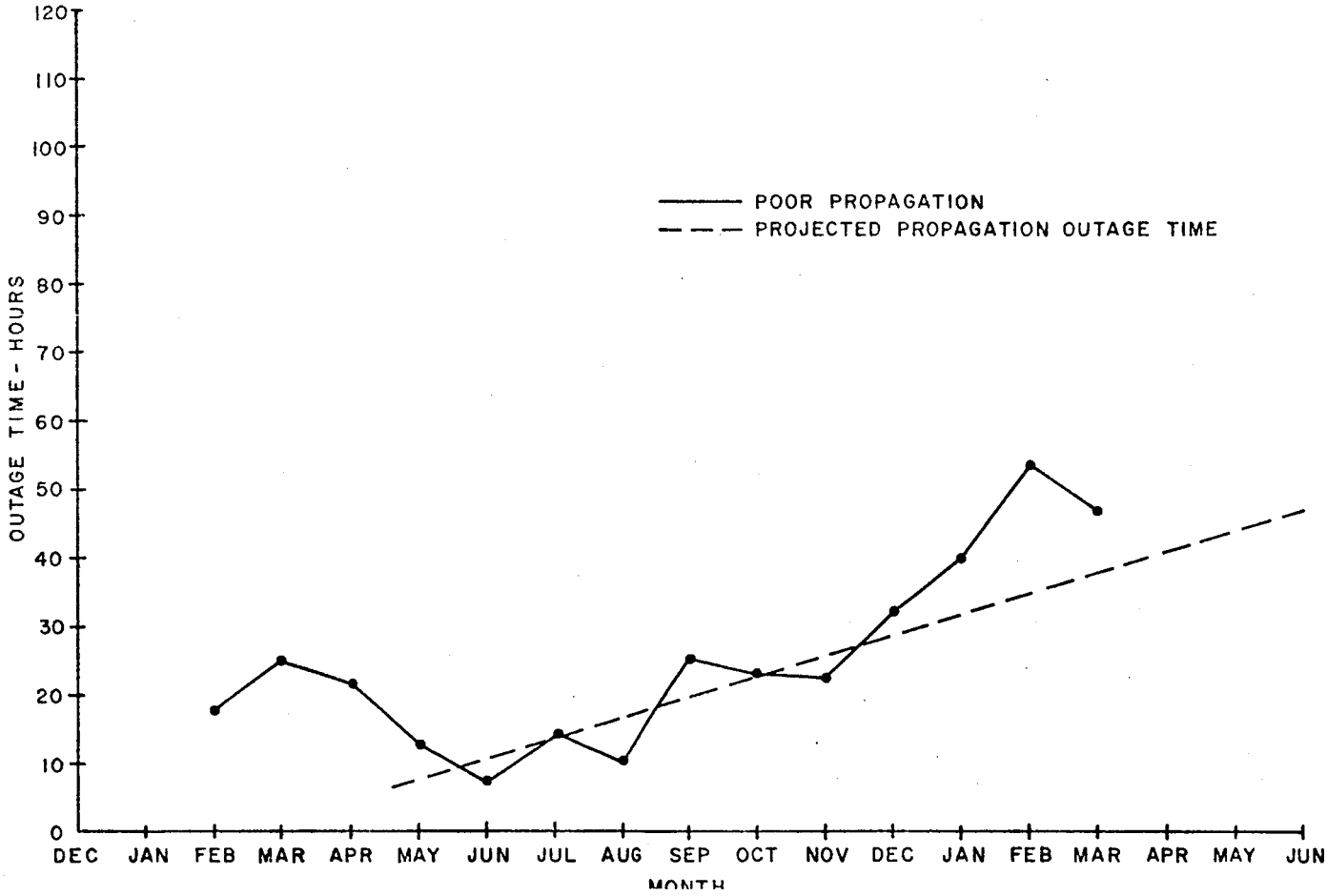


Figure 3. Expanded Graph of Propagation Outages (Hours)

By referring to Figure 3 in this report, it will be noted that the realized propagation conditions through March 1963 are actually running somewhat higher than the projected propagation conditions. This deviation between the projected and realized conditions has been accelerating from November through January, resulting in a downward trend in the realized outage time noted from February into March.

Recommendations For Circuit Improvement

An unusually high failure rate occurred at the Honolulu office in March, as indicated below:

TROUBLE CATEGORIES	OUTAGE TIME
A No trouble found	:10
B Line, cable, or microwave	11:25
C Operator error	1:29
D Equipment adjustment	1:34
E Equipment failure	5:05
P Power failure	1:47
TOTAL OUTAGE TIME	21:30 hours

The line-cable-microwave facilities which are the means of interconnecting the other stations in the Mercury network with the Honolulu facility accounted for more than one-half (11:25 hours) of the total outage time at Honolulu. The 11:25 hours occurred on March 31 as a single uninterrupted outage. The log indicates that this outage occurred because of a cable failure between Hawaiian Telephone Company and RCA-Honolulu.

An equipment failure occurred on this circuit on March 1 which resulted in 5:05 hours continuous outage time. The reason for this outage, according to the GSFC 22-35A trouble tickets, was a defective patch cord at FAA-Honolulu. The Honolulu facility is of prime importance as a major intermediate station for several branches of the Mercury network, including the Australian circuits. These are totally dependent on Honolulu for interconnection to GSFC.

Because of the importance of Honolulu in the Mercury network, it is imperative that a preventive maintenance program of a more comprehensive level be instituted—and pursued—to prevent a recurrence of the prolonged outages that occurred on March 1 and March 31, which seriously degrade the reliability of the network.

NETWORK TELETYPEWRITER PERFORMANCE ANALYSIS BY SITES

General

In this section of this report are Tables 2 and 3, presenting various aspects of the performance (outage time, reliability, interruptions, etc.) of the Mercury network teletypewriter communications system by individual stations for March 1963. A summary of the number of interruptions on each of the circuits, tabulated by months and covering the 6-month period of October 1962 through March 1963, is shown in Table 4. Part-time circuits and order-wire circuits are not included in this tabulation.

Table 2
March Teletypewriter Lost Time by Trouble Categories

CIRCUIT	STATION	TROUBLE CATEGORIES* (Hours and Minutes)									TOTAL LOST TIME (Hours and Minutes)	TOTAL OPERATING TIME (Hours and Minutes)	RELIABILITY (Percent)	
		A	B	C	D	E	F	G	I	P			March	5-Month Average
7005-30T	BDA	:14	-	-	-	:50	-	-	-	-	1:04	171	99.38	99.46
-30R	BDA	-	-	:06	-	-	-	-	-	-	:06	171	99.94	99.65
-31T	BDA	:14	-	-	-	-	-	-	-	-	:14	171	99.84	99.44
-31R	BDA	-	-	:06	-	-	-	-	-	-	:06	171	99.94	99.63
-11T	CNV	-	:25	-	-	-	-	-	-	-	:25	504	99.92	99.95
-11R	CNV	-	:25	-	-	-	-	-	-	-	:25	504	99.92	99.85
-13T	MCC	-	-	-	-	-	-	-	-	-	0:00	504	100.00	99.99
-14T	MCC	-	-	-	-	-	-	-	-	-	0:00	504	100.00	99.97
-15T	MCC	-	:25	-	-	-	:52	-	-	-	1:17	744	99.82	99.76
-15R	MCC	-	:47	-	-	-	-	-	-	-	:47	744	99.89	99.94
-18T	MCC	-	:25	-	-	-	-	-	-	-	:25	504	99.92	99.76
-19T	MCC	-	:25	-	-	-	-	-	-	-	:25	504	99.92	99.92
-22T	MCC	:25	5:25	-	:52	-	-	-	-	-	6:42	504	98.67	99.14
-22R	MCC	:10	5:25	-	:53	-	-	-	-	-	6:28	504	98.72	99.22
-23T	MCC	:25	-	-	:15	2:40	-	-	-	-	3:20	504	99.30	99.05
-23R	MCC	:35	-	-	-	-	-	-	-	-	:35	504	99.88	98.81
-04T	CAL	:15	:07	2:00	-	-	-	-	-	-	2:22	744	99.68	99.62
-04R	CAL	:08	:32	2:00	-	-	-	-	-	-	2:40	744	99.60	99.56
-05T	GYM	:10	9:52	-	-	:12	-	-	-	-	10:14	744	98.57	99.31
-05R	GYM	:10	9:26	-	-	-	-	-	-	-	9:36	744	98.71	98.79
-06T	WHS	:08	:51	-	-	-	-	-	-	-	:59	314:30	99.69	99.76
-06R	WHS	-	1:13	-	-	-	-	-	-	-	1:13	314:30	99.61	99.84
-07T	TEX	-	-	-	-	-	-	-	-	-	0:00	310:15	100.00	99.81
-07R	TEX	-	-	-	-	-	-	-	-	-	0:00	310:15	100.00	99.87
-08T	EGL	-	-	-	-	:18	-	-	-	-	:18	229	99.87	99.67
-08R	EGL	-	-	-	-	-	-	-	-	-	0:00	229	100.00	99.84
-02T	ADE	1:41	3:36	:10	-	4:32	-	10:00	-	:04	20:03	744	97.30	98.33
-02R	ADE	:07	1:55	:28	-	5:39	-	10:00	-	-	18:09	744	97.57	98.59
-02T	CTN	-	1:09	-	-	1:11	-	2:37	:20	-	5:17	330	98.70	98.62
-02R	CTN	-	:30	:20	-	2:18	-	14:50	-	-	17:58	330	94.56	97.06
-02T	MUC	:19	:39	:02	-	1:54	-	:04	-	-	2:58	146:15	97.97	97.71
-02R	MUC	-	:31	-	-	1:42	-	-	-	-	2:13	146:15	98.48	98.58
-02T	WOM	:17	1:26	:02	-	:52	-	:04	-	-	2:41	138	98.06	98.27
-02R	WOM	:05	1:26	-	-	:50	-	-	-	-	2:21	138	98.30	99.12
-02T	HAW	-	1:44	-	-	:10	-	-	-	-	1:54	321:40	99.41	99.42
-02R	HAW	-	-	-	-	-	-	-	-	-	0:00	321:40	100.00	99.45

Table 2 (Continued)

CIRCUIT	STATION	TROUBLE CATEGORIES* (Hours and Minutes)									TOTAL LOST TIME (Hours and Minutes)	TOTAL OPERATING TIME (Hours and Minutes)	RELIABILITY (Percent)	
		A	B	C	D	E	F	G	I	P			March	5-Month Average
7005-03T	HAW	-	1:14	-	:15	-	-	-	-	-	1:29	321:40	99.54	99.53
-03R	HAW	-	:35	-	-	-	-	-	-	-	:35	321:40	99.82	99.44
-17T	CYI	-	:43	-	:05	-	-	1:05	-	-	1:53	268	99.30	98.15
-17R	CYI	:20	:15	-	-	:48	-	:56	-	:08	2:27	268	99.09	96.52
-17T	ZZB	-	-	:36	:05	:13	-	-	-	:03	:57	321:35	99.71	98.11
-17R	ZZB	:07	-	-	-	2:58	-	4:00	1:06	-	8:11	321:35	97.46	96.41
-17T	KNO	-	-	-	:05	:07	-	-	-	-	:12	327	99.94	98.61
-17R	KNO	:07	-	:34	-	2:48	-	4:21	1:06	-	8:56	327	97.00	96.29
	TOTAL	5:57	51:26	6:24	2:30	30:02	:52	47:57	2:32	:15	147:55	17,731:50	99.16	99.04

*Legend:

A = No trouble found
B = Line, cable, or microwave
C = Operator error
D = Equipment adjustment
E = Equipment failure
F = Wiring defect
G = Poor propagation
I = Interference
P = Power failure

Table 3
March Teletypewriter Interruptions by Trouble Categories

CIRCUIT	STATION	TROUBLE CATEGORIES* (Number of Interruptions)									
		A	B	C	D	E	F	G	I	P	TOTAL
7005-30T	BDA	1	-	-	-	1	-	-	-	-	2
-30R	BDA	-	-	1	-	-	-	-	-	-	1
-31T	BDA	1	-	-	-	-	-	-	-	-	1
-31R	BDA	-	-	1	-	-	-	-	-	-	1
-11T	CNV	-	1	-	-	-	-	-	-	-	1
-11R	CNV	-	1	-	-	-	-	-	-	-	1
-13T	MCC	-	-	-	-	-	-	-	-	-	0
-14T	MCC	-	-	-	-	-	-	-	-	-	0
-15T	MCC	-	1	-	-	-	1	-	-	-	2
-15R	MCC	-	3	-	-	-	-	-	-	-	3
-18T	MCC	-	1	-	-	-	-	-	-	-	1
-19T	MCC	-	1	-	-	-	-	-	-	-	1
-22T	MCC	2	2	-	-	2	-	-	-	-	6
-22R	MCC	1	2	-	-	2	-	-	-	-	5
-23T	MCC	-	1	-	1	4	-	-	-	-	6
-23R	MCC	-	2	-	-	-	-	-	-	-	2
-04T	CAL	1	1	1	-	-	-	-	-	-	3
-04R	CAL	1	3	1	-	-	-	-	-	-	5
-05T	GYM	3	6	-	-	1	-	-	-	-	10
-05R	GYM	3	6	-	-	-	-	-	-	-	9
-06T	WHS	1	1	-	-	-	-	-	-	-	2
-06R	WHS	-	1	-	-	-	-	-	-	-	1
-07T	TEX	-	-	-	-	-	-	-	-	-	0
-07R	TEX	-	-	-	-	-	-	-	-	-	0
-08T	EGL	-	-	-	-	2	-	-	-	-	2
-08R	EGL	-	-	-	-	-	-	-	-	-	0
-02T	ADE	7	8	2	-	11	-	13	-	1	42
-02R	ADE	2	3	2	-	11	-	13	-	-	31
-02T	CTN	-	3	-	-	3	-	2	1	-	9
-02R	CTN	-	1	1	-	2	-	10	-	-	14
-02T	MUC	2	3	1	-	5	-	1	-	-	12
-02R	MUC	-	2	-	-	5	-	-	-	-	7
-02T	WOM	2	4	1	-	4	-	1	-	-	12
-02R	WOM	1	4	-	-	2	-	-	-	-	7
-02T	HAW	-	4	-	-	1	-	-	-	-	5
-02R	HAW	-	-	-	-	-	-	-	-	-	0
-03T	HAW	-	3	-	1	-	-	-	-	-	4
-03R	HAW	-	3	-	-	-	-	-	-	-	3
-17T	CYI	-	1	-	1	-	-	2	-	-	4
-17R	CYI	1	1	-	-	1	-	3	-	-	6
-17T	ZZB	-	-	1	1	2	-	-	-	1	5
-17R	ZZB	1	-	-	-	6	-	8	1	-	16
-17T	KNO	-	-	1	-	1	-	-	-	-	2
-17R	KNO	1	-	1	-	6	-	8	1	-	17
	TOTAL	31	73	14	4	72	1	61	3	2	261

*Legend:
A = No trouble found
B = Line, cable, or microwave
C = Operator error
D = Equipment adjustment
E = Equipment failure
F = Wiring defect
G = Poor propagation
I = Interference
P = Power failure

Number of Interruptions

Table 4 lists the number of interruptions (transmit and receive combined) for each teletypewriter circuit in the Mercury network for the past six months, and the average duration of interruption in March.

Table 4
Teletypewriter Number of Interruptions

CIRCUIT	STATION	MARCH AVG.*	NUMBER OF INTERRUPTIONS					
			OCT 1962	NOV 1962	DEC 1962	JAN 1963	FEB 1963	MAR 1963
7005-30	BDA	23	7	3	4	3	2	3
-31	BDA	10	7	6	5	3	3	2
-11	CNV	25	3	5	0	2	2	2
-13	MCC	0	1	0	1	1	0	0
-14	MCC	0	1	1	0	1	0	0
-15	MCC	19	11	4	2	4	2	5
-18	MCC	25	3	1	7	2	0	1
-19	MCC	25	4	1	0	3	0	1
-22	MCC	72	14	8	9	5	12	11
-23	MCC	29	20	10	19	18	11	8
-04	CAL	38	11	1	9	6	5	8
-05	GYM	63	24	15	14	19	11	19
-06	WHS	44	2	6	1	4	0	3
-07	TEX	0	2	0	4	2	0	0
-08	EGL	9	4	6	4	3	2	2
-02	ADE	31	23	38	53	58	39	73
-02	CTN	53	16	5	22	20	21	25
-02	MUC	13	13	29	14	25	29	19
-02	WOM	16	8	8	2	9	12	19
-02	HAW	19	8	2	4	14	4	5
-03	HAW	18	3	4	8	13	3	7
-17	CYI	26	31	16	23	34	25	10
-17	ZZB	26	32	17	32	37	30	21
-17	KNO	29	23	19	34	48	22	19
	TOTAL	34	271	205	271	300	235	261

*Average period of interruption to nearest minute for March.

TELETYPEWRITER PERFORMANCE, DISCUSSION, AND GRAPHICAL ANALYSES

General

This section of the report summarizes the performance of the several circuits on an individual basis for March 1963. Each analysis is presented in tabular form, and is compared with the two preceding months, January and February 1963.

In addition to this, graphical presentations covering a 12-month period of individual circuit reliabilities are also included. Circuits selected for graphical analysis are those whose reliability changed significantly over the past 12-month period; circuits which show a consistently high degree of reliability are not plotted. Where several sites are on the same circuit, only that station which is most distant from Goddard Space Flight Center will be analyzed graphically. Circuits selected for graphical analysis may change from time to time according to the reliability characteristics of the circuits and of the network.

Outage Time and Reliability - Bermuda

BDA-30 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	:09	-	:14	-	-	-
B. Line, cable, microwave	:04	-	-	-	-	-
C. Operator error	-	-	-	-	-	:06
E. Equipment failure	-	2:10	:50	:05	2:10	-
TOTAL OUTAGE	:13	2:10	1:04	:05	2:10	:06
RELIABILITY (Percent)	99.88	98.80	99.38	99.95	98.80	99.94

BDA-31 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	-	-	:14	:06	-	-
B. Line, cable, microwave	:02	-	-	:02	-	-
C. Operator error	-	-	-	-	-	:06
D. Equipment adjustment	-	-	-	-	:10	-
E. Equipment failure	-	2:10	-	-	2:10	-
TOTAL OUTAGE	:02	2:10	:14	:08	2:20	:06
RELIABILITY (Percent)	99.98	98.80	99.84	99.92	98.70	99.94

Summary

There were three troubles reported on the two Bermuda circuits (BDA-30; BDA-31) during March, with no two troubles occurring in any one category. The result was an increase in reliability on both the transmit and receive sides of each circuit compared with February. Except for the transmit side of BDA-30, the reliability of both of these circuits is above the 10-month average of approximately 99.6% (based on ten months transmit and receive time combined). The lower reliability of the transmit side of BDA-30 (in comparison with the transmit side of BDA-31) was the result of an interruption of 50 minutes duration when the reperforator section of a reperforator-transmitter was dropping the "S" character intermittently.

No interruptions occurred simultaneously on the two transmit sides of the circuit. This fact is of considerable import since the transmit circuit to Bermuda is of paramount importance during missions requiring the transmission of capsule commands.

No graphical analysis is shown for BDA-30 or BDA-31 (see page 10).

Outage Time and Reliability - Guaymas

GYM-05 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:12	-	:10	:20	-	:10
B. Line, cable, microwave	7:36	:53	9:52	11:18	:28	9:26
E. Equipment failure	:17	3:50	:12	-	11:38	-
TOTAL OUTAGE	8:59	4:43	10:14	11:38	12:06	9:36
RELIABILITY (Percent)	98.73	99.30	98.57	98.35	98.20	98.71

Summary

While the table above shows no consistent trend—either upward or downward—in reliability, inspection of the 12-month graph (see Fig. 4) reveals that reliability of the Guaymas-05 circuit has been generally declining since November. The downtrend is primarily due to increased outage time in the line-cable-microwave category. The November totals of lost time in this category were 1:09 hours transmit time and 59 minutes receive time, as compared with more than 9 hours on each path during March.

One trouble resulted in 8:25 hours outage time on each path in the line failure category. This unusually prolonged outage occurred on March 3, when a truck knocked down the carrier pole and cut the lines between Guaymas and the station.

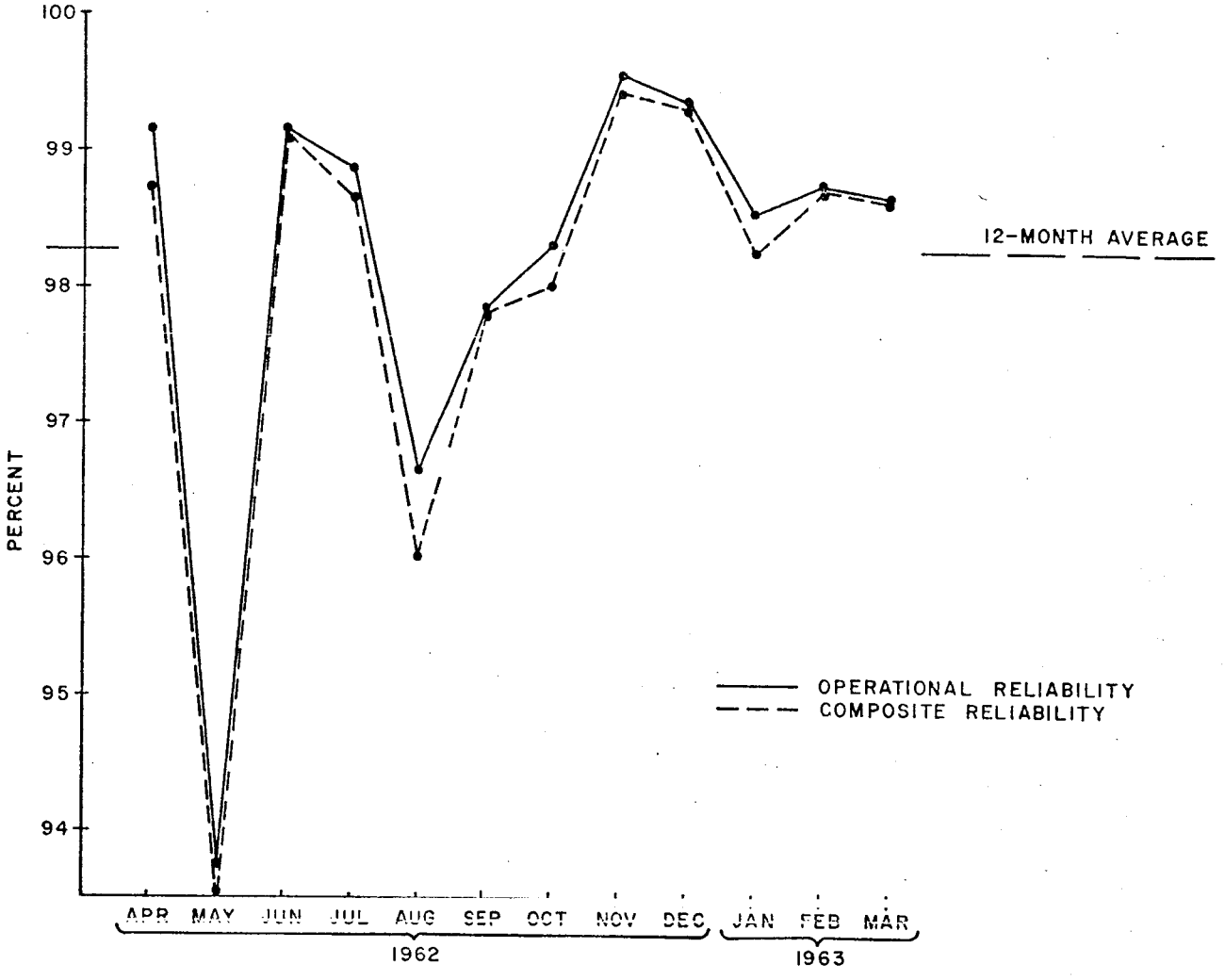
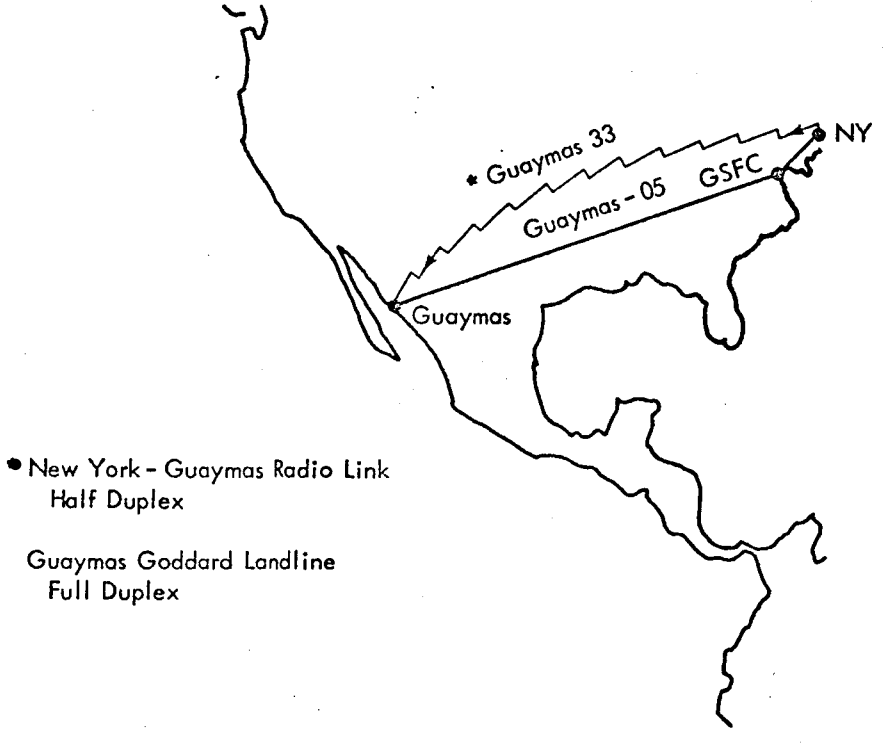


Figure 4. Teletypewriter Reliability (Percent) Guaymas (GYM-05)



Outage Time and Reliability - MUCHEA

MUC-02 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	-	-	:19	-	-	-
B. Line, cable, microwave	1:13	2:48	:39	1:15	1:59	:31
C. Operator error	-	:17	:02	-	:17	-
E. Equipment failure	2:42	:35	1:54	:55	:34	1:42
G. Poor propagation	-	-	:04	-	-	-
M. Maintenance	-	(3:50)	-	-	(3:50)	-
P. Power failure	:18	:09	-	:11	:19	-
TOTAL OUTAGE	4:13	3:49	2:58	2:21	3:09	2:13
RELIABILITY (Percent)	97.68	97.67	97.97	98.71	98.08	98.48

Summary

Reliability of the Muchea-02 circuit has shown less tendency to vary over the past four months as compared with preceding months (see Fig. 5). During March, both transmit and receive reliabilities increased from their respective February figures.

The reliability of the receive side of this circuit has been consistently higher than the transmit side since November 1962. Preceding months' data was not considered on an individual transmit and receive basis, but rather on a combined basis. This is the reason analysis of the transmit side and the receive side of the circuit is not made on an individual basis prior to November 1962. The principal reason for the greater incidence of outage time on the transmit side of the circuit has been a higher rate of equipment failure. The greater difference in equipment failure outages between the transmit and receive sides occurred in November, December, and January. In February, line failures were the principal cause of the difference between transmit and receive reliabilities, with the transmit side again having more outage time. In March, every category represented shows more lost time on the transmit side than on the receive side.

Equipment failures on this circuit, as in previous months, occurred at intermediate stations and not at Muchea. Except for 9 minutes lost time on each path, all of the equipment failure lost time was caused by circuit failures at Honolulu. Two of these failures were caused by regenerative repeaters in the transmit circuit at Honolulu.

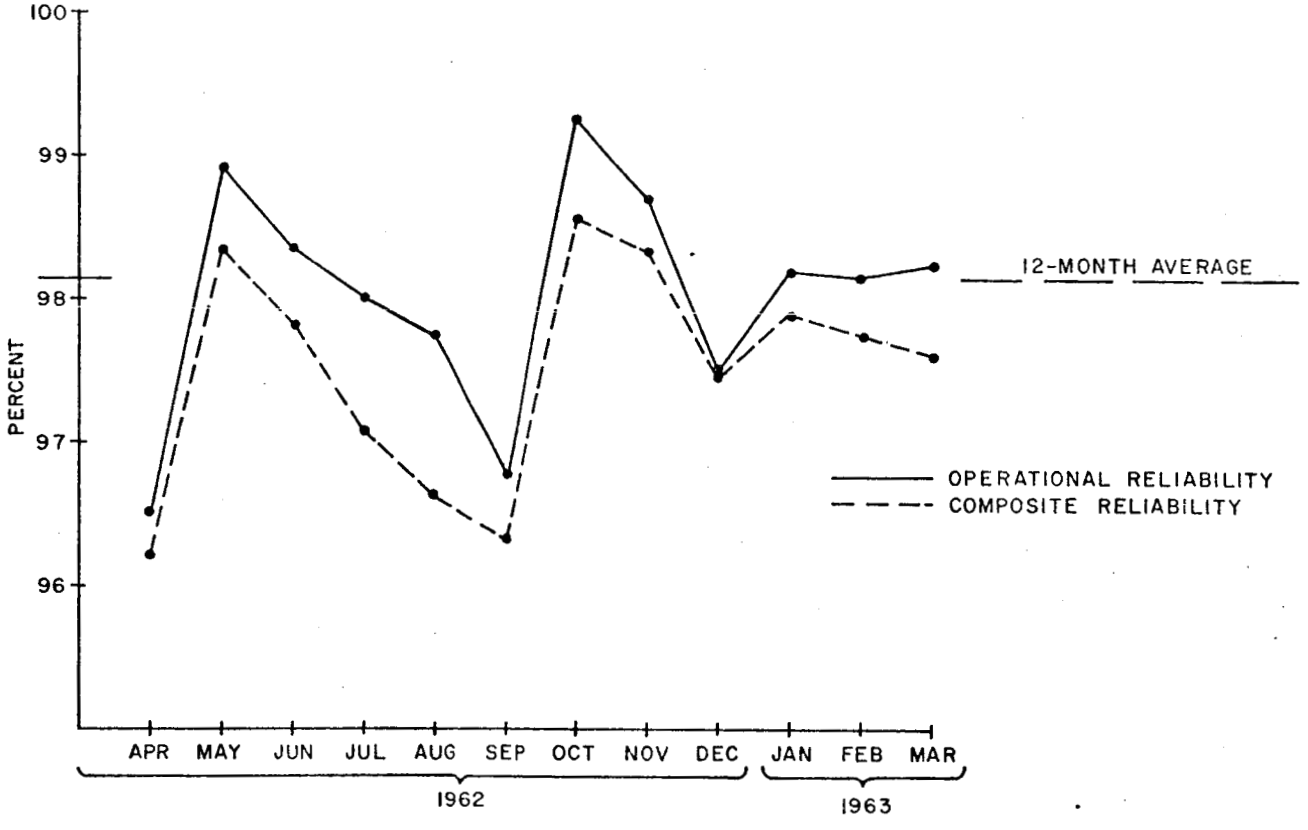
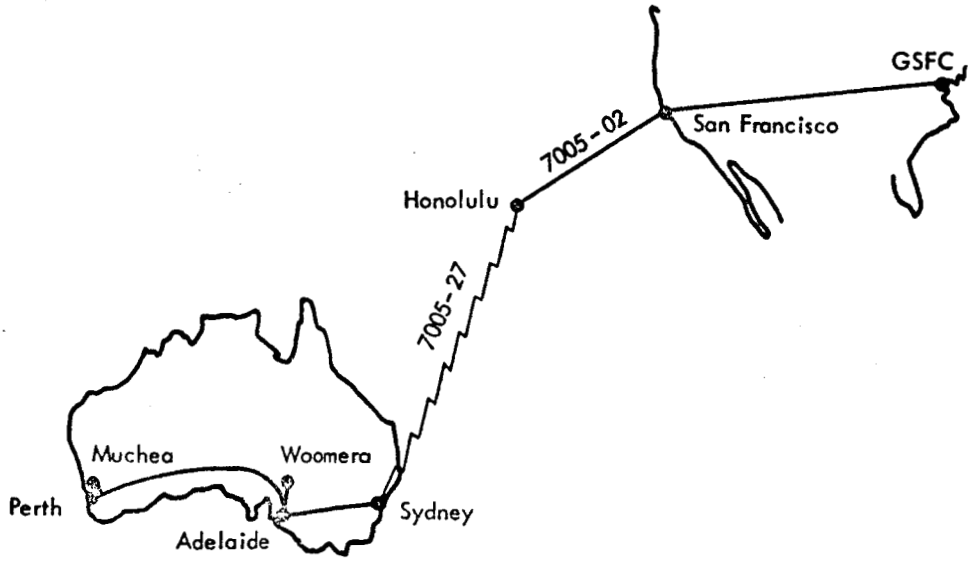


Figure 5. Teletypewriter Reliability (Percent) Muchea (MIC-02)



Outage Time and Reliability - Adelaide

ADE-02 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	2:12	-	1:41	:47	-	:07
B. Line, cable, microwave	2:34	1:16	3:36	1:22	:38	1:55
C. Operator error	:04	-	:10	:40	:20	:28
E. Equipment failure	4:15	:54	4:34	2:32	1:39	5:39
G. Poor propagation	:51	4:20	10:00	:51	5:22	10:00
I. Interference	-	-	-	-	:20	-
M. Maintenance	-	-	-	-	-	(:05)
P. Power failure	1:00	:22	:04	:48	:27	-
TOTAL OUTAGE	10:56	6:54	20:05	7:00	8:46	18:09
RELIABILITY (Percent)	98.53	98.97	97.30	99.06	98.70	97.57

Summary

Reliability of both the transmit and receive paths of the Adelaide-02 circuit has been decreasing for the past three months, as is evident from the table above. The primary cause is the steadily worsening propagation conditions over the three-month period. Total outage time is nearly equally divided between both legs of the circuit, with just slightly greater outage incidence on the receive path. Most of the outage time due to poor propagation occurred daily between 1400Z and 2000Z, with outages as long as 2:45 hours. Reliability during this period of time is approximately 94.6% (considering only propagation outages) on both sides of the circuit, which agrees reasonably well with the predicted reliability for the period as furnished by the National Bureau of Standards. It is difficult to determine the exact predicted reliability because of the manner in which the NBS predictions are presented, which use increments of 2 hours in time and 2 megacycles in frequency. It has been recommended that prior to the forthcoming MA-9 mission predictions be prepared and compiled, using the frequencies actually assigned to the several sites associated with the ARQ on this path.

A propagation failure in one direction on the ADE-02 circuit will result in an identical failure of the circuit in the opposite direction because of the ARQ on this path. According to our latest records at GSFC, the lowest frequency available from Sydney to Honolulu is 7.335 mc. The MUF (maximum usable frequency) at 1600Z is 6.4 megacycles. Therefore, the propagation lost time on both sides of this circuit is undoubtedly caused by failure of the Sydney to Honolulu path, as a result of not having available a lower transmitting frequency at Sydney. Honolulu is authorized to transmit on 5.095 mc. A frequency of this order would improve reliability of the circuit for Sydney.

No graphical analysis is shown for the ADE-02 circuit (see page 10).

Outage Time and Reliability - Hawaii

HAW-02 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:50	-	-	:23	-	-
B. Line, cable, microwave	:56	:59	1:44	:17	:15	-
E. Equipment failure	-	-	:10	-	-	-
P. Power failure	:20	-	-	:20	-	-
TOTAL OUTAGE	3:06	:59	1:54	1:00	:15	0:00
RELIABILITY (Percent)	99.12	99.73	99.41	99.72	99.92	100.00

HAW-03 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	:33	-	-	:45	-	-
B. Line, cable, microwave	1:30	:10	1:14	:28	-	:35
C. Operator error	:13	-	-	-	-	-
D. Equipment adjustment	-	:05	:15	-	-	-
F. Wiring defect	-	:24	-	-	-	-
P. Power failure	:26	-	-	:20	-	-
TOTAL OUTAGE	2:36	:39	1:29	1:33	0:00	:35
RELIABILITY (Percent)	99.26	99.79	99.54	99.56	100.00	99.82

Summary

Nearly all of the outage time on these two circuits during March was in the line-cable-microwave failure category. The longest interruption was of 35 minutes duration on the transmit path of both HAW-02 and HAW-03 circuits. This interruption was caused by microwave failure between Honolulu and Kauai. Three of the failures in this category on the HAW-03 circuit occurred in the vicinity of Atlanta. One interruption occurred on the transmit side, and one on the receive side, while the third interruption occurred in both directions. Transmit outage time resulting from these troubles totaled 29 minutes; receive lost time was 39 minutes. Other outages in this category were caused by failures at several locations.

On March 4, from approximately 1900Z to 2100Z the transmit side of Hawaii-02 was impaired, although the circuit was not out totally. Hawaii was then switched to the order wire channel in order to permit checking the condition of the circuit from both ends. During this time, errors were received on the regular 7005-02 as well as the alternate order wire, and also some errors were noted on the 7005-03 circuit. These comparision tests were sent during this period with a total of 567 errors. The 1900Z test had the largest number—480 total. The combined rate for the three tests was 246 per thousand characters transmitted. Since there are no fixed standards established at the present time, a decision concerning whether or not a circuit is considered usable in a case such as the above must depend on the personal opinion of operations personnel. A standards report and guide is currently being produced by this Section; this will alleviate this situation as soon as it is completed and all operating personnel have been furnished with a copy. No graphical analysis is presented of the HAW-02 and HAW-03 reliability characteristics (see page 10).

Outage Time and Reliability - Woomera

WOM-02 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	:36	-	:17	:11	-	:05
B. Line, cable, microwave	-	1:01	1:26	-	:15	1:26
C. Operator error	:04	-	:02	-	:20	-
E. Equipment failure	2:20	:13	:52	:10	-	:50
G. Poor propagation	-	-	:04	-	-	-
P. Power failure	:10	:21	-	-	:26	-
TOTAL OUTAGE	3:10	2:05	2:41	:51	1:31	2:21
RELIABILITY (Percent)	96.32	98.43	98.06	99.01	98.86	98.30

Summary

Performance of the Woomera-02 circuit during March nearly equalled that of the past several months from a reliability standpoint. Reliability of both transmit and receive paths decreased slightly from February, but was very close to the combined transmit and receive 10-month average of 98.1% (based on the last 10 months).

Over one-half of the lost time on both send and receive paths was caused by failures in the line-cable-microwave category. There were four troubles; all were on the Australian continent, and all interrupted both the send and receive paths. Three of the four troubles were line failures between Adelaide and Sydney. The fourth failure was between Adelaide and Woomera, and resulted in 20 minutes of outage time on each side of the circuit.

All of the equipment failure outage time during March was caused by failures at Honolulu. There were four troubles, two of which were regenerative repeater failures in the transmit circuit, and resulted in 49 minutes of total outage time. The lost time (12 minutes) in the no-trouble-found category of the transmit path also occurred on Hawaii, and may have been caused by a repeater failure.

No graphical presentation is shown for the WOM-02 circuit (see page 10).

Outage Time and Reliability - Canton Island

CTN-02 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:05	-	-	:27	-	-
B. Line, cable, microwave	:55	:35	1:09	-	:35	:30
C. Operator error	-	-	-	-	-	:20
E. Equipment failure	:04	:01	1:11	:13	-	2:18
G. Poor propagation	2:01	4:09	2:37	1:50	15:31	14:50
I. Interference	-	-	:20	-	-	-
P. Power failure	:48	:07	-	:45	:07	-
TOTAL OUTAGE	4:53	4:52	5:17	3:45	16:13	17:58
RELIABILITY (Percent)	98.02	98.46	98.40	98.48	94.85	94.56

Summary

Reliability of the Canton Island circuit during March remained relatively unchanged from the previous month; however, there has been a pronounced downward trend over the past five months (see Fig. 6). During February the principal cause of lost time on the circuit was poor propagation, which was also the case in March, with the preponderance of failures occurring on the receive side of the circuit. Receive reliability was 3.84 percent lower than reliability on the transmit side, with receive lost time (due to poor propagation) 5.7 times that logged on the transmit side. As is evident from the table above, the same situation prevailed in February. As stated in the February report, this condition of pronounced and continuing poor propagation is not compatible with the National Bureau of Standards propagation predictions, and much of the lost time logged to propagation difficulties was probably due to other causes; the most likely of these causes is interference.

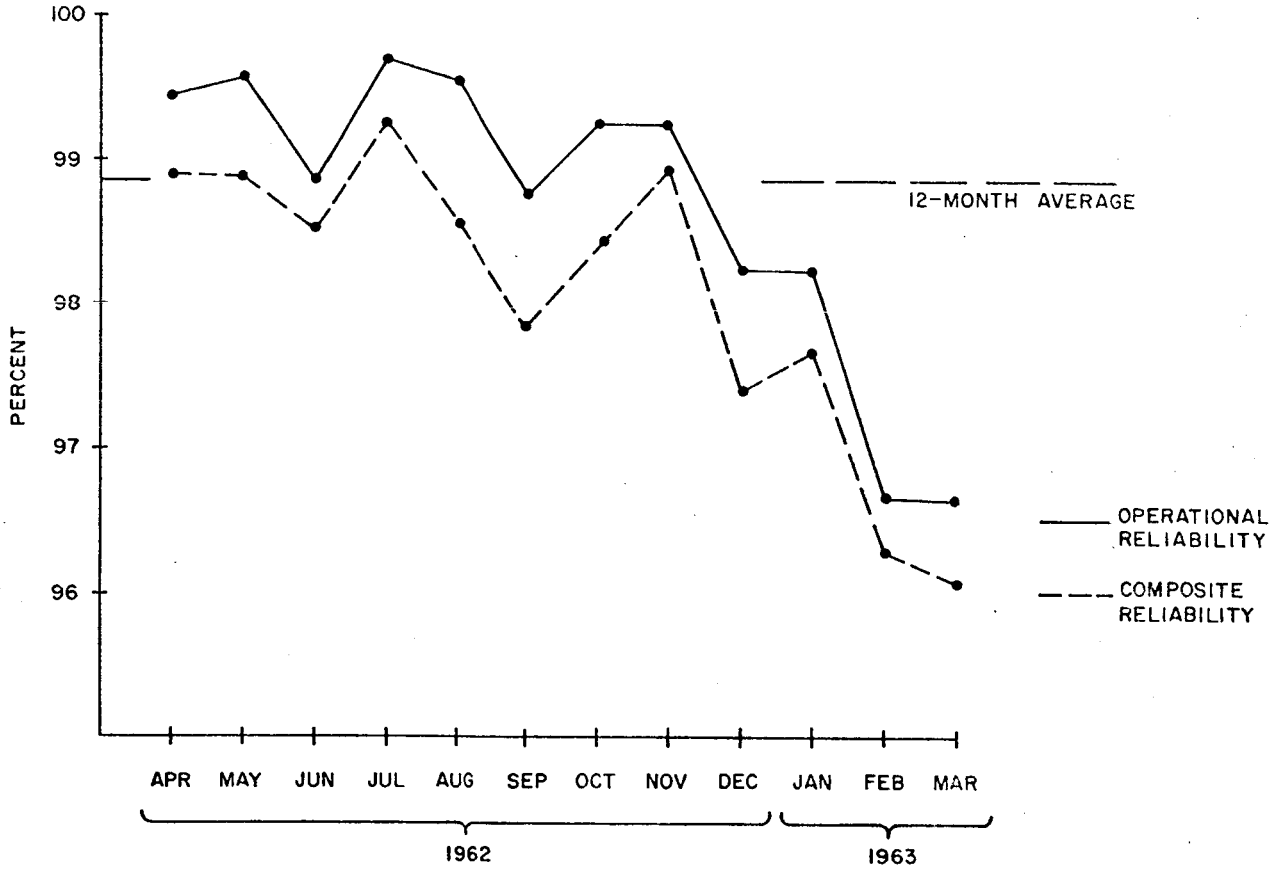
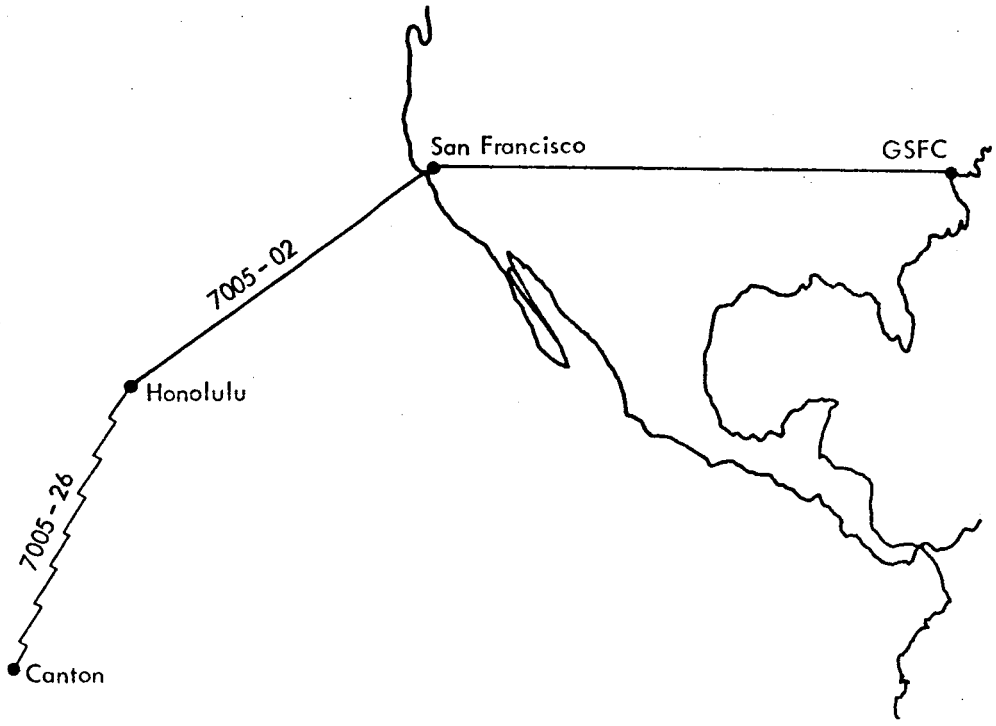


Figure 8. Teletypewriter Reliability (Percent) Canton Island (CTN 02)



Outage Time and Reliability - Grand Canary Island

CYI-17 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:17	-	-	:45	:45	:20
B. Line, cable, microwave	3:29	2:55	:43	9:09	3:00	:15
C. Operator error	:20	-	-	-	-	-
D. Equipment adjustment	:10	-	:05	1:10	:02	-
E. Equipment failure	1:59	:07	-	1:39	-	:48
G. Poor propagation	1:20	:50	1:05	3:56	4:53	:56
I. Interference	-	-	-	:27	-	-
P. Power failure	:33	:42	-	:02	:22	:08
TOTAL OUTAGE	9:08	4:34	1:53	16:41	9:02	2:27
RELIABILITY (Percent)	96.77	98.22	99.30	94.11	96.50	99.09

Summary

The Grand Canary Island 7005-17 circuit performed more reliably in March than in any preceding month since July 1962 (see 12-month graph, Fig. 7). Poor propagation was the major cause of circuit outage time in March, followed by line-cable-microwave failure and equipment failure in that order.

A 40-minute poor propagation outage on the GSFC transmit path from 0155Z-0235Z on 15 March is noteworthy. CADFISS (Computer and Data Flow Integrated Sub System) tests were being conducted. At 0155Z, the Canary Island station informed GSFC that they were closing the circuit because the GSFC transmissions were unreadable because of poor propagation. GSFC logged out the circuit at 0155Z and continued the outage until the CADFISS tests were terminated at 0235Z. In this instance, neither GSFC nor the NASA London office received any notice from Canary prior to 0155Z that the circuit was degraded. It is highly important that the NASA London office and the GSFC Facilities Control Section be notified hereafter whenever this circuit is operating at less than 100 percent reliability. Operating personnel are requested to follow this policy.

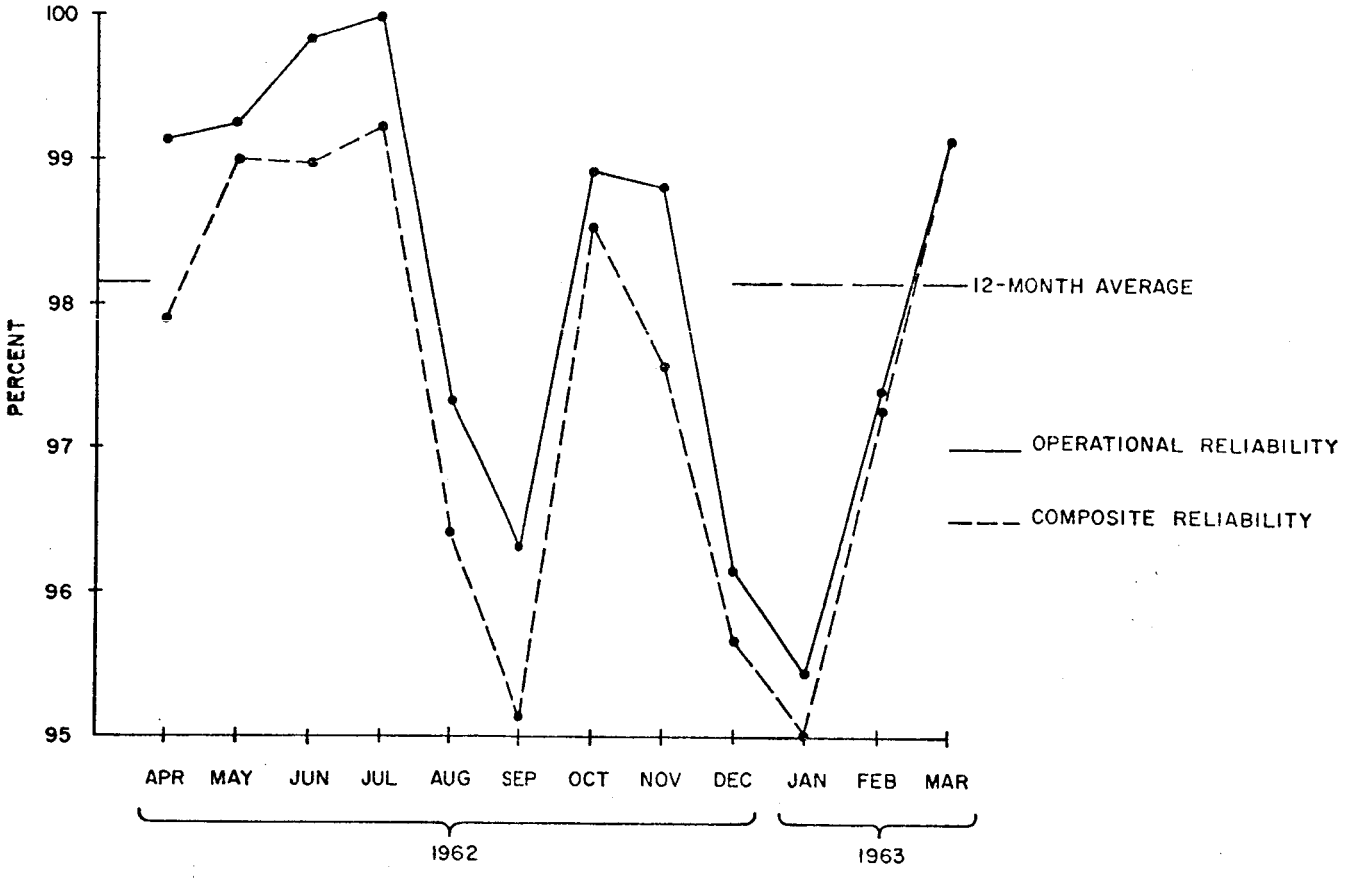
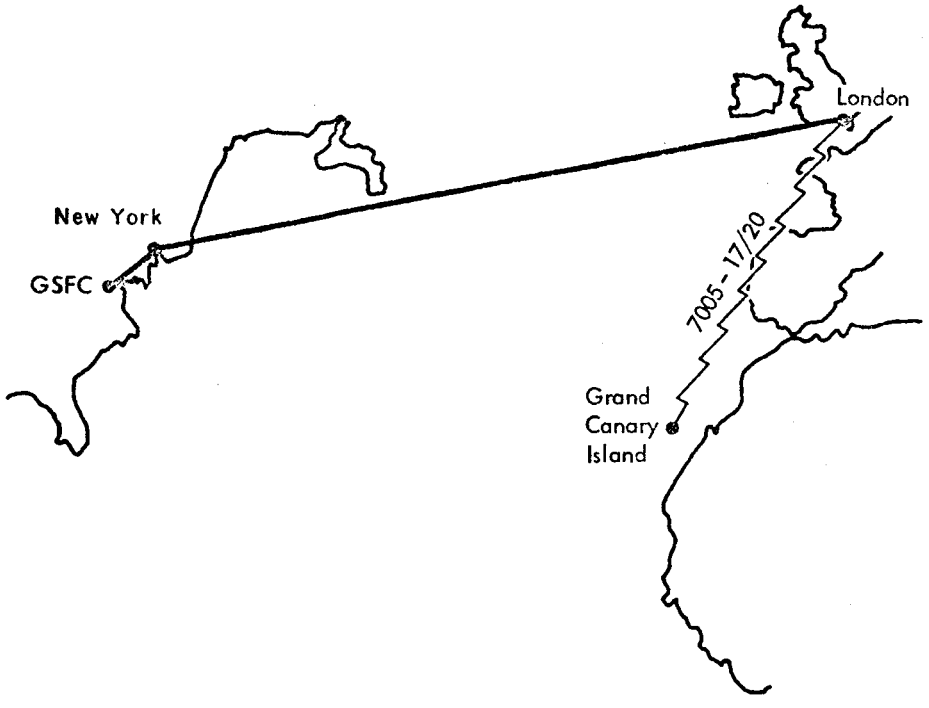


Figure 7. Teletypewriter Reliability (Percent) Grand Canary Island (CYI-17)



Outage Time and Reliability - Zanzibar

ZZB-17 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	4:02	-	-	-	-	:07
B. Line, cable, microwave	:27	2:50	-	:27	3:00	-
C. Operator error	3:30	:45	:36	3:30	-	-
D. Equipment adjustment	-	:06	:05	-	-	-
E. Equipment failure	:40	-	:13	1:49	3:58	2:58
G. Poor propagation	2:25	2:50	-	6:26	9:53	4:00
I. Interference	1:40	-	-	1:40	:25	1:06
P. Power failure	:36	:04	:03	:08	:04	-
TOTAL OUTAGE	13:20	6:35	:57	14:00	17:20	8:11
RELIABILITY (Percent)	96.03	97.92	99.71	95.83	94.51	97.46

Summary

The Zanzibar 7005-17 circuit performed with considerably higher reliability in March than during the preceding two months (see Fig. 8). The GSFC transmit path to Zanzibar attained a reliability index of 99.71 percent. The operational reliability of the GSFC receive path from Zanzibar was 97.46 percent in March. The total outage time decreased by approximately one-half from the January and February figures.

The analysis of the causes of the reported outages on the GSFC/Zanzibar circuit in March from all sources is revealing. None of these failures occurred at Zanzibar or on the HF radio paths between Kano and Zanzibar. The outages due to poor propagation have been covered in the Kano section of this report; reference should be made to this section. Equipment failures beyond Zanzibar were responsible for 2:58 hours of lost circuit time. Over one-half of this total (2:58 hours) occurred on 15 March, when three outages (totaling 1:47 hours) were reported as having been caused by equipment failures at the London receiver site.

The marked difference in total outage time between the transmit and receive paths of this circuit, due to equipment failures, is of considerable concern. If taken at face value, these figures indicate that the equipment on the GSFC receive path must be receiving less preventive maintenance than the equipment on the GSFC transmit path, and, therefore, is more subject to failure. A more logical conclusion is that GSFC personnel are being more thorough than site personnel in reporting circuit failures.

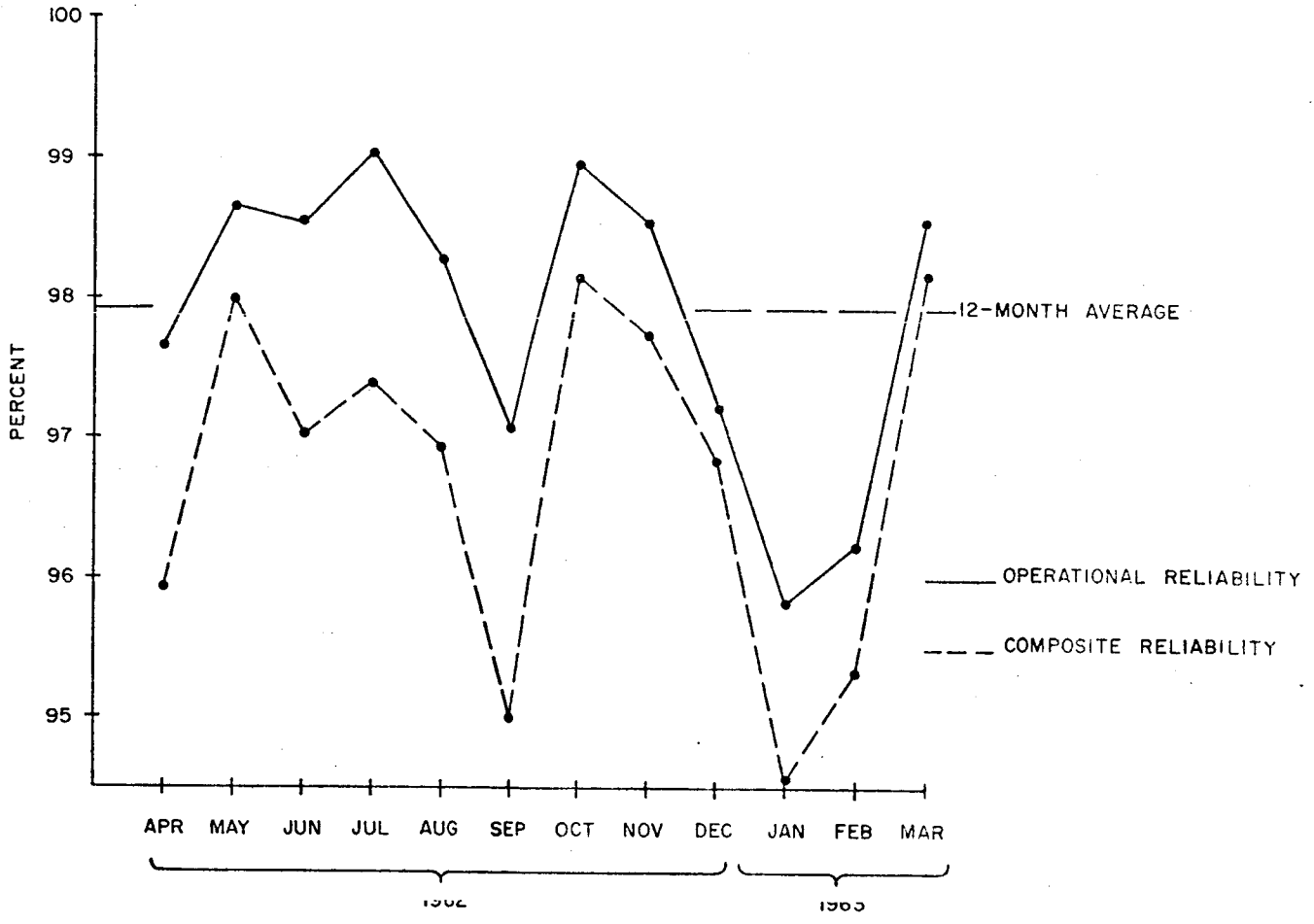
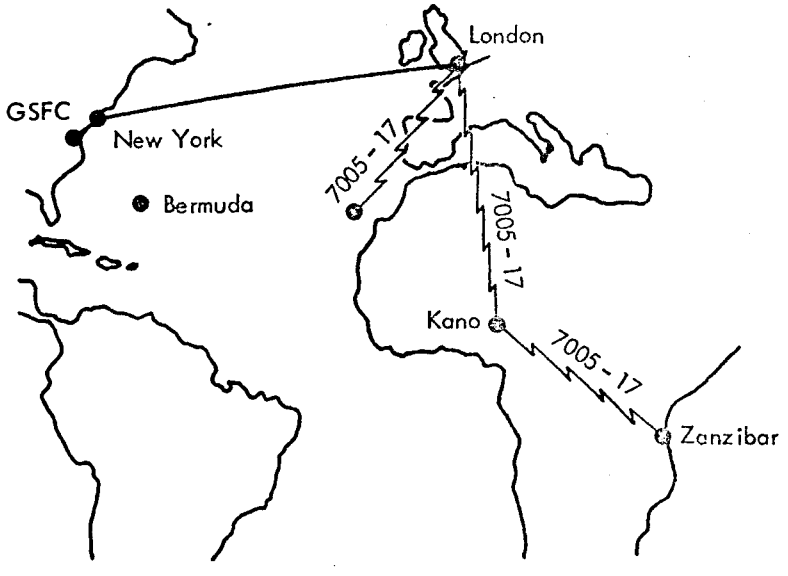


Figure 8. Teletypewriter Reliability (Percent) Zanzibar (ZZB-17)



Outage Time and Reliability - Kano

KNO-17 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:17	-	-	2:49	-	:07
B. Line, cable, microwave	-	2:50	-	-	3:00	-
C. Operator error	:35	-	-	:25	-	:34
D. Equipment adjustment	-	-	:05	-	-	-
E. Equipment failure	1:24	:31	:07	2:13	1:13	2:48
G. Poor propagation	2:48	-	-	13:07	5:22	4:21
I. Interference	2:55	-	-	-	:52	1:06
P. Power failure	1:04	:04	-	:33	-	-
TOTAL OUTAGE	10:03	3:25	:12	22:02	10:27	8:56
RELIABILITY (Percent)	97.10	98.93	99.94	93.65	96.73	97.00

Summary

The GSFC transmit path of the 7005-17 circuit to Kano, Nigeria, attained the high reliability index of 99.94 percent in March. Less than 15 minutes of outage time was recorded during the entire month.

The reliability of the GSFC receive path from Kano was 97 percent. Approximately 60 percent of the 8:56 hours of total outage time was caused by propagation failures and interference. A comparison of outages caused by poor propagation of the GSFC transmit and receive paths may be made by referring to the above table. The January, February, and March results show quite clearly that the HF radio path from Kano to London is much less reliable than the London to Kano path. The London and Kano transmitter powers and antenna configurations are identical. The noise grade is higher at Kano than in the United Kingdom. Therefore, it appears that the assignment of additional transmitting frequencies of a lower frequency at Kano, comparable to those employed by the London transmitters, will increase the reliability of the GSFC receive path. It is recommended that action be initiated to accomplish this at the earliest practicable date.

No graphical analysis is shown for the KNO-17 circuit (see page 10).

(CNV-11; MCC-13; MCC-14;
MCC-15, MCC-18; MCC-19;
MCC-22; MCC-23)

(Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	1:16	3:43	:25	1:21	3:27	:10
B. Line, cable, microwave	6:02	1:21	7:30	2:31	2:21	7:12
C. Operator error	6:00	-	-	2:10	-	-
D. Equipment adjustment	-	:20	:15	-	:20	-
E. Equipment failure	3:15	4:30	3:32	2:49	4:45	:53
F. Wiring defect	-	-	:52	-	-	-
P. Power failure	-	2:10	-	-	-	-
TOTAL OUTAGE	16:33	12:04	12:34	8:51	10:53	8:15
RELIABILITY (Percent)	99.64	99.69	99.71	99.63	99.45	99.63

Summary

The table above is the summation of all Mercury Control Center and Cape Canaveral circuits except the order wire, MCC-12. Since the transmit and receive paths are analyzed individually and there are more transmit circuits than receive circuits, transmit operating time is greater. Therefore, it is possible to have more lost time and still show greater reliability on the transmit path when compared with the receive path. This situation was true during each of the months in the above table. Percentage reliability and lost time by trouble categories of the individual circuits for March are listed in Table 2.

Reliability of the transmit circuits has shown a slight upward trend over the past three months, while the receive reliability of 99.63 percent during March was above February's reliability, and then dropped to the same level as January. As can be seen from the table above, these minor changes in reliability were not caused by decreased outage time in any one category.

During March, as was the case in February, the MCC-22 circuit had the lowest reliability of any of these circuits. The reliability figures of the transmit and receive paths were nearly equal (98.67 and 98.72 percent, respectively) each with identical lost time (5:25) in the line-cable-microwave failure category, which represents approximately 80% of the lost time on the circuit. Five hours of the 5:25 hours was lost when the circuit failed in both directions between Cape Canaveral and Orlando. The trouble started at 0740Z (2:40 am local time), when maintenance personnel were not readily available, and, consequently, prolonged the outage time on both the transmit and receive legs.

Other Circuits

Prior to this March Mercury Network Report, circuits discussed and analyzed in this section of the report have all been considered on the basis of the transmit and receive path total outages combined. With this report, and future Mercury Reliability Reports, transmit and receive reliability characteristics on each of the circuits will be considered on an individual basis. In consonance with this policy, the four circuits, viz, CAL-04, EGL-08, TEX-07, and WHS-06 of the Mercury network have been classified according to transmit and receive paths, starting with January through March. This permits a better and more meaningful analysis to be made of each section of each circuit.

It is apparent by referring to the EGL-08 and TEX-07 tables that no interruptions were reported on either the transmit path or the receive path of either circuit in March.

Two hours were logged against both sides of the CAL-04 circuit in March. This was the result of failure of the operator at the California site to respond on being contacted by the GSFC operator. The California operator, on being queried, stated that he had been busily preoccupied with duties in connection with the Pacific Missile Range circuits, and had been unable to answer. In similar situations in the future, operating personnel at the distant sites are directed to close the circuit to GSFC in order to prevent a similar recurrence.

The performance of the WHS-06 circuit in March did not equal that which was attained in February, when no outage time was experienced on either side. Nevertheless, March reliability of both the transmit and receive sides of WHS-06 was extremely good—99.69 percent transmit; 99.61 percent receive. This approximated very closely the average 99.62 percent reliability index attained over the 10-month period prior to March with the transmit-receive paths evaluated on a combined basis.

The greater portion of outage time on both the transmit and receive paths in March was caused by line-cable-microwave problems. One single failure caused 51 minutes of outage time on both sides of the circuit. This occurred between Atlanta and Dallas. This outage was corrected by re-routing.

Outage Time and Reliability - California

CAL-04

(Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	-	-	:15	:19	:05	:08
B. Line, cable, microwave	:19	:40	:07	-	:40	:32
C. Operator error	:58	-	2:00	:58	-	2:00
F. Wiring defect	-	5:35	-	-	5:35	-
M. Maintenance	(4:45)	-	-	(4:45)	-	-
P. Power failure	:01	-	-	:01	-	-
TOTAL OUTAGE	1:18	6:15	2:22	1:18	6:20	2:40
RELIABILITY (Percent)	99.82	99.07	99.68	99.82	99.06	99.60

Outage Time and Reliability - Eglin AFB

EGL-08

(Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
B. Line, cable, microwave	-	-	-	:10	-	-
C. Operator error	-	1:30	-	-	-	-
E. Equipment failure	-	-	:18	-	-	-
F. Wiring defect	-	:30	-	-	-	-
P. Power failure	:03	-	-	:03	-	-
TOTAL OUTAGE	:03	2:00	:18	:13	0:00	0:00
RELIABILITY (Percent)	99.98	99.20	99.87	99.92	100.00	100.00

Outage Time and Reliability - Texas

TEX-07 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
B. Line, cable, microwave	:28	-	-	:28	-	-
TOTAL OUTAGE	:28	0:00	0:00	:28	0:00	0:00
RELIABILITY (Percent)	99.78	100.00	100.00	99.78	100.00	100.00

Outage Time and Reliability - White Sands

WHS-06 (Hours and Minutes)

TROUBLE CATEGORIES	TRANSMIT (from GSFC)			RECEIVE (at GSFC)		
	JAN	FEB	MAR	JAN	FEB	MAR
A. No trouble found	-	-	:08	-	-	-
B. Line, cable, microwave	-	-	:51	:10	-	1:13
C. Operator error	1:00	-	-	-	-	-
E. Equipment failure	:20	-	-	-	-	-
M. Maintenance	(:25)	-	-	(:25)	-	-
TOTAL OUTAGE	1:20	0:00	:59	:10	0:00	1:13
RELIABILITY (Percent)	99.59	100.00	99.69	99.95	100.00	99.61

PROJECT MERCURY SCAMA RELIABILITY

An analysis of the Mercury SCAMA (Switching, Conferencing, and Monitoring Arrangements) Telephone Network is shown in tabular form in Tables 5, 6, and 7. Table 5 is an analysis of telephone network outage time for March 1963 by individual circuits, with the reliability index of each circuit shown. Table 6 shows the total number of interruptions per month, as well as the average lost time per interruption over the 12-month period, April 1962 through March 1963. Table 7 shows the SCAMA network circuit interruption categorized on the basis of the cause of the interruptions.

The month of March marks the first time that the Johannesburg voice circuit was included in the report. This circuit does not directly support the Mercury mission. However, it has been included in this report because of a requirement for an order wire channel to London during the MA-9 mission. Approximately 32 hours of lost time was logged against this voice circuit because of frequency changes on the London-Johannesburg radio path. This type of interruption occurred 43 times, with an average outage of 43 minutes per interruption, which was supposedly lost each time frequency changes were required. The longest interruption of this type was 4:20 hours. Since a frequency change should normally require only 10 to 15 minutes of lost time, it is evident that most of the outage time attributed to this category was actually caused by something else, such as poor propagation or interference. Since inclusion of Johannesburg in the SCAMA totals in the various tables would give erroneous figures in the totals for the network, Johannesburg voice circuit data is listed separately. Steps are currently being taken to insure the validity of future data on this circuit.

The number of telephone circuit interruptions for March was 189, with an average outage time per interruption of 50 minutes. This represents more than a 26 percent increase in the number of interruptions over February, which had a total of 150 circuit interruptions, with an average outage per interruption of 48 minutes. There has been a monthly increase in SCAMA circuit interruptions since November, when the total for that month was only 39 interruptions.

The greatest cause of outage time in March on the SCAMA network was poor propagation (73:30 hours), with line-cable-microwave (51:40 hours) problems running second. These two trouble categories accounted

for 79.47 percent of the total telephone circuit outage time, with all other troubles combined causing the remainder of the lost circuit time (20.53 percent).

The total scheduled operating time (all circuits) on the SCAMA network in March was 9322 hours. Thus, with a total outage time of 157:30 hours, the realized reliability index for March was 98.4 percent, a decrease of .3 percent from the February reliability figure. Nevertheless, it is believed that greater diligence in the use of the NBS propagation forecasts and more expeditious correction of line-cable-microwave troubles which are reported will improve performance and, consequently, the circuit reliability.

Table 5
Mercury Telephone Outage Time Analysis by Trouble Categories,
March 1963 : CAMA Network

CIRCUIT (Gov. Phone No.)	STATION	TROUBLE CATEGORIES*									TOTAL LOST TIME (Hours and Minutes)	SCHEDULED OPERATING TIME (Hours)	RELIABILITY (Percent)
		A	B	C	D	E	G	I	K	P			
2288	MCC #1	-	-	-	-	-	-	-	-	-	-	504	100
2289	#2	-	-	-	-	-	-	-	-	-	-	504	100
2290	#3	:27	-	-	-	-	-	-	-	-	:27	504	99.9
2291	#4	-	-	-	-	-	-	-	-	-	-	504	100
2292	#5	-	-	-	-	-	-	-	-	-	-	504	100
2293	#6	-	:19	-	-	-	-	-	-	-	:19	504	99.9
2465	#7	-	:24	-	-	-	-	-	-	-	:24	504	99.9
52059	#8	-	:14	-	-	-	-	-	-	-	:14	504	99.9
1078	GYM #1	-	8:40	-	-	-	-	-	-	-	8:40	744	98.8
52011	#2	-	-	-	-	-	-	-	-	-	-	744	100
1274	BDA #1	-	-	-	-	-	-	-	-	-	-	171	100
1431	#2	-	-	-	-	-	-	-	-	-	-	171	100
52060	CYI	-	1:34	-	:54	-	2:32	-	-	:07	5:07	268	98.1
52060	KNO	:59	-	-	:45	-	6:11	-	-	-	7:55	327	97.6
52060	ZZB	1:13	-	:21	:55	:14	8:20	-	-	-	11:03	322	96.6
1266	EGL	-	-	-	-	-	-	-	-	:20	:20	229	99.9
1267	TEX	-	-	-	-	-	-	-	-	-	-	310	100
1268	WHS	-	-	-	-	-	-	-	-	-	-	314	100
1269	CAL	-	:08	:39	-	-	-	-	-	-	:47	744	99.9
2296	HAW	:58	:15	-	-	-	-	-	-	-	1:13	322	99.6
2296	MUC	1:22	18:31	:31	1:25	:46	4:28	:17	-	:02	37:22	146	74.4
2296	WOM	1:22	18:31	:17	1:25	:46	4:28	:17	-	:02	37:08	138	73.1
2296	CTN	3:18	:15	1:29	1:57	6:49	7:31	:22	-	1:45	43:26	330	86.8
1145	WLP	:16	-	-	-	-	-	-	-	-	:16	170	99.8
52061	HOU #1	-	1:12	-	-	-	-	-	-	-	1:12	177	99.3
52120	HOU #2	-	1:37	-	-	-	-	-	-	-	1:37	170	99.0
	TOTAL	9:55	51:40	3:17	7:21	8:35	3:30	:56	-	2:16	157:30	9822	98.4
52392	JOBURG	2:09	8:13	-	:58	3:00	7:46	-	31:57	5:05	139:08	744	81.3

*Legend:
A = No trouble found
B = Line, cable, or microwave
C = Operator error
D = Equipment adjustment
E = Equipment failure
G = Poor propagation
I = Interference
K = Frequency change
P = Power failure

Table 6
Mercury Telephone Outage Time by Months SCAMA Network
(12-Month Period)

MONTH	OUTAGE TIME (Hours and Minutes)	INTERRUPTIONS	AVERAGE OUTAGE PER INTERRUPTION (Hours and Minutes)
Mar. 1963	157:30	189	:50
Feb. 1963	120:47	150	:48
Jan. 1963	37:13	76	:29
Dec. 1962	22:29	42	:32
Nov. 1962	30:22	39	:46
Oct. 1962	31:54	76	:25
Sep. 1962	110:11	116	:57
Aug. 1962	56:00	77	:43
Jul. 1962	108:14	62	1:43
Jun. 1962	65:54	66	1:00
May 1962	50:38	59	:51
Apr. 1962	34:35	45	:46

Table 7
Mercury Telephone Circuit Interruptions,
March 1963 SCAMA Network

CIRCUIT (Gov. Phone No.)	STATION	TROUBLE CATEGORIES*									TOTAL INTERRUPTIONS
		A	B	C	D	E	G	I	K	P	
2288	MCC #1	-	-	-	-	-	-	-	-	-	-
2289	#2	-	-	-	-	-	-	-	-	-	-
2290	#3	1	-	-	-	-	-	-	-	-	1
2291	#4	-	-	-	-	-	-	-	-	-	-
2292	#5	-	-	-	-	-	-	-	-	-	-
2293	#6	-	2	-	-	-	-	-	-	-	2
2465	#7	-	3	-	-	-	-	-	-	-	3
52059	#8	-	1	-	-	-	-	-	-	-	1
1078	GYM #1	-	1	-	-	-	-	-	-	-	1
52011	#2	-	-	-	-	-	-	-	-	-	-
1274	BDA #1	-	-	-	-	-	-	-	-	-	-
1431	#2	-	-	-	-	-	-	-	-	-	-
52060	CYI	-	2	-	2	-	4	-	-	1	9
52060	KNO	1	-	-	3	-	7	-	-	-	11
52060	ZZB	2	-	2	4	1	7	-	-	-	16
1266	EGL	-	-	-	-	-	-	-	-	1	1
1267	TEX	-	-	-	-	-	-	-	-	-	-
1268	WHS	-	-	-	-	-	-	-	-	-	-
1269	CAL	-	1	1	-	-	-	-	-	-	2
2296	HAW	8	1	-	-	-	-	-	-	-	9
2296	MUC	10	9	2	5	1	14	2	-	1	44
2296	WOM	10	9	1	5	1	14	2	-	1	43
2296	CTN	11	1	2	3	4	18	3	-	1	43
1145	WLP	1	-	-	-	-	-	-	-	-	1
52061	HOU #1	-	1	-	-	-	-	-	-	-	1
52120	#2	-	1	-	-	-	-	-	-	-	1
	TOTAL	44	32	8	22	7	64	7	0	5	189
52392	JOBURG	5	3	-	4	1	65	-	43	1	122

*Legend:

A = No trouble found
B = Line, cable, or microwave
C = Operator error
D = Equipment adjustment
E = Equipment failure
G = Poor propagation
I = Interference
K = Frequency change
P = Power failure

HIGH SPEED DATA CIRCUITS

There are four full duplex high speed data circuits between GSFC and Cape Canaveral (GD-1262, GD-1263, GD-1264, and GS-1325) within the Mercury network. No interruptions were reported on Nos. 1262 and 1265 during March.

Two full duplex high speed data circuits, Nos. GDA-52027 and GDA-52028, link GSFC with Bermuda. Likewise, no outages were reported on either of these two circuits during March.

The following tables summarize the lost time totals of the circuits on which interruptions did occur in March, with transmit and receive total outage time combined.

Circuit GD-1263

TROUBLE CATEGORIES	TIME LOST
A. No trouble found	:35
B. Line, cable, or microwave	13:30
C. Operator error	1:45
D. Equipment adjustment	:55
TOTAL (Hours and Minutes)	16:45
RELIABILITY (Percent)	98.84

Circuit GD-1264

TROUBLE CATEGORIES	TIME LOST
B. Line, cable, or microwave	13:30
D. Equipment adjustment	:35
TOTAL (Hours and Minutes)	14:05
RELIABILITY (Percent)	99.02

As can be seen from these tables, troubles in the line-cable-microwave failure category accounted for the greatest amount of lost time for these two circuits (80.6 percent on GD-1263; 95.9 percent on GD-1264).

One trouble resulted in 13:30 hours of outage time on each circuit as a result of transmit carrier failure. This represents all of the outage time on both GD-1263 and GD-1264 logged to this category. The interruption was caused by high line amplitude and fluctuations in amplitude.

HF PROPAGATION CONSIDERATIONS

Conditions During March

Propagation conditions continued to improve during March, and were in fact above normal for this time of year, by the end of the month. This is in contrast with the unseasonal slump in propagation conditions which occurred during December and January. The improvement is attributed, at least in part, to a slight increase in solar activity. This increased activity resulted in a somewhat higher effective sunspot number than was expected.

The NBS-predicted monthly mean sunspot number was 25 for March. The actual mean sunspot number, as reported by the Zurich Observatory, was 16.9. However, the realized mean effective sunspot number was 30.

The regular, or Wolf, sunspot number for each day is obtained by multiplying the number of sunspot groups by ten and adding the number of single sunspots observable. The monthly mean sunspot number, then, is the

average of the daily sunspot numbers. The effective sunspot number is the theoretical Wolf sunspot number which would be required to support the observed HF radio propagation conditions. The basis for calculation of the effective sunspot number is the measurement of the highest frequency which is reflected by the ionosphere at vertical incidence.

There was a moderate propagation disturbance during the period of March 10—13. There were no sudden ionospheric disturbances (SID).

Propagation Outlook for May

Long range propagation predictions for May have been issued to most of the Mercury stations. In the near future, it is planned that these long range predictions will be furnished by the Systems Analysis Section to all HF stations serving NASA. It should be noted that these long range predictions represent the average of the expected conditions, and do not include the effects of recurring solar storms.

At this writing, there is little reason to expect any significant departures from the predicted conditions. A 27-day recurring solar disturbance may return during the period of May 1—3. This is an old storm, however, which has been steadily declining in intensity with each 27-day recurrence. If this disturbance does return, it should be comparatively mild. A mild propagation disturbance which occurred during April 13—15 may herald the start of a new 27-day recurrent storm. If this materializes, it can be expected to return with increased intensity during the period of May 11—13.

APPENDIX I

TROUBLE CATEGORY CODE DESIGNATIONS

Code A - NO TROUBLE FOUND - Cause unknown, trouble cleared before a definite location could be obtained, or cause and location unobtainable.

Code B - LINE, CABLE, OR MICROWAVE - Failure of cable, microwave, or other similar connecting facilities between stations.

Code C - OPERATOR ERROR - Faults occurring as a result of the human element, such as: operation of equipment not in proper sequence, and inserting or removing patch cords improperly.

Code D - EQUIPMENT ADJUSTMENT - Faults caused by maladjustment of any equipment.

Code E - EQUIPMENT FAILURE - Faults caused by failure of any electrical or mechanical part of the circuit.

Code F - WIRING DEFECT - Faults caused by any wiring defect.

Code G - POOR PROPAGATION - Radio path failure due to fading, low signal strength, or high atmospheric noise level.

Code I - INTERFERENCE - Any loss of signal intelligence due to other radio signal interference (QRM).

Code K - FREQUENCY CHANGE - Loss of contact due to frequency change.

Code M - MAINTENANCE - Lost time due to unscheduled maintenance. Scheduled maintenance is not considered an outage for analysis purposes.

Code P - POWER FAILURE - Failure of station due to loss of input or primary power at that station.

APPENDIX II

DATA SOURCES

Data used in this report have been obtained from:

- Trouble Tickets, GSFC Form 22-35
- Analysis of Circuit Operation, GSFC Form 22-10
- NASA Circuit Log, GSFC Form 22-8T
- Daily Communications Reports (DCR)

Trouble tickets provide most of the data analyzed in this report. Trouble categories have been devised as a common basis for recording and interpreting trouble data, and these categories have been extended and refined as shown in Appendix I. The Facilities Control Group has been furnished this trouble code for logging purposes, inasmuch as that group writes the trouble tickets. These tickets are classified at GSFC in accordance with the trouble code specified; thus, interruption patterns can be examined quantitatively without repeated review of each ticket. When apparent discrepancies or ambiguities exist in any of the information related to the several stations' operation, as received through the above channels, the Analysis Section then communicates directly with those sites to obtain clarification.

APPENDIX III

CIRCUIT DESIGNATIONS

TELETYPEWRITER CIRCUIT		STATION	SITE	TELEPHONE (SCAMA)
7005-01	Part-time ckt	CSQ	Coastal Sentry (Ship)	
7005-01	Part-time ckt	WOM	Woomera, Australia	
7005-01	Part-time ckt	MUC	Muchea, Australia	
7005-02		ADE	Adelaide, Australia	
7005-02		HON	Honolulu, Hawaii	GP-2296
7005-03		HAW	Kauai, Hawaii	GP-2296
7005-04		CAL	Pt. Arguello, Calif.	GP-1269
7005-05		GYM	Guaymas, Mexico	GP-1078
7005-06		WHS	White Sands, N. Mex.	GP-1268
7005-07		TEX	Corpus Christi, Tex.	GP-1267
7005-08		EGL	Eglin, Fla.	GP-1266
7005-12	O/Wire	BDA	Bermuda	
7005-11		CNV		GP-52029
7005-12	O/Wire	MCC		GP-2288
7005-13	S/Only	MCC		GP-2289
7005-14	S/Only	MCC	Mercury Control	
7005-15		MCC		GP-2290
7005-18	S/Only	MCC	Center, Cape	GP-2291
7005-19	S/Only	MCC		GP-2292
7005-22	R/Only	MCC	Canaveral	GP-2293
7005-23	R/Only	MCC		GP-2465
7005-17		CYI	Grand Canary Island	GP-52060
7005-17		KNO	Kano, Nigeria	GP-52060
7005-17		ZZB	Zanzibar, Africa	GP-52060
7005-20	Part-time ckt	CYI	Grand Canary Island	
7005-21	O/Wire	LDN	London, England	
7005-21	Part-time ckt	KNO	Kano, Nigeria	
7005-25/02		HAW	Kauai, Hawaii	GP-2296
7005-26/02		CTN	Canton Island	GP-2296
7005-27/02		MUC/	Muchea/Woomera,	GP-2296
7005-27/02		WOM	Australia	GP-2296
7005-30		BDA	Bermuda	GP-1274
7005-31		BDA	Bermuda	GP-1431
7005-33	HF Backup	GYM	Guaymas, Mexico	GP-52011